Ingeteam

Ingecon®Sun String Control

Installation manual

AAS2002IKI01_B
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This document is subject to change.

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1. Overview

This manual contains information about the features and installation of the Ingecon® Sun String Control unit.

Read this manual and follow the installation instructions carefully.

1.1. Specifications

Ingecon® Sun String Control	
Maximum number of connectable strings	16
Maximum number of measurable channels	16
Maximum current per string	10 Adc
Maximum total current	160 Adc
Number of protection fuses	16
Maximum voltage	1000 Vdc
Input connectors	Type 3 or 4 PV array connectors
Output connectors	M40 (up to 240 mm^2)
Communications connections	RS-485, GSM/GPRS, Ethernet, wireless, optical fibre
Ambient temperature	-20 °C to +65 °C
Protection class	IP65
Earthing connector	M16 (10 to 25 mm^2)

1.2. General safety precautions

CAUTION

Do not open the equipment. This operation can only be performed by authorised personnel.

CAUTION

The operations detailed below may only be carried out by personnel appropriately qualified, trained in electrical subjects and with knowledge of this manual and the panel's electrical diagrams (hereinafter qualified personnel). You are reminded of the obligation to comply with 614/2001 applicable to electrical work. Danger of electric shock.

CAUTION

The fact that the various enclosures of the compartments are open in no way implies the absence of voltage. Only qualified personnel following the safety guidelines described in this document may access the compartments.

CAUTION

The set of conditions listed below should be considered as minimum requirements. It is always preferable to cut the general power and make sure there is no voltage. Installation defects may result in unwanted feedback. Danger of electric shock.

CAUTION

In addition to the security measures listed in this manual, the general measures that apply in this area (specific to the installation, country, etc.) should be complied with.

CAUTION

Remember that the installation company should considered qualified workers to be those who at least meet with the requirements of Royal Decree 614/2001 for electrical work.

CAUTION

The unit must be voltage-free prior to any handling. As a minimum security measure in this operation, the so-called **five golden rules** should always be followed:

1. Disconnect.
2. Prevent any possible resupply.
3. Check there is no voltage.
4. Ground and short circuit
5. Protect from live elements, if any, and put up safety signs around the work zone.

CAUTION

Category III - 1000-Volt measuring instruments must be used.

CAUTION

Ingeteam Energy, S.A. is not liable for any damages caused by improper use of its equipment.

1.3. Task Description

The work that qualified personnel can carry out on this model are as follows:

- **Inspection**: Involves opening the enclosure for visual inspection tasks.
- **Control**: Tasks such as loading software, checking the air cooling systems and corrective maintenance on the equipment, not including electrical panels, carried out via the display and man-machine interface.
- **Handling**: Tasks involving the assembly and/or replacement of parts and configuring the protection system.

The following warnings should be born in mind in any Inspection, Control and Handling task:

CAUTION

Ingecon® Sun String Control equipment can only be opened by qualified personnel for installation, commissioning and maintenance tasks.

CAUTION

There is serious risk of electric shock even after disconnecting the unit from the inverter and the solar panels.

Wait 10 minutes to allow internal capacitances to discharge after disconnecting panels and inverter.

CAUTION

The use of personal protective equipment (PPE) is mandatory:

- Dielectric gloves suitable for the operating voltage.
- Gloves for protection against mechanical hazards.
- Safety goggles approved for electrical hazards.
- Safety footwear.

In handling tasks, take into account also that:

CAUTION

The equipment may not be handled in any way if there is a chance of the unit being connected to a power source.

Conduct an electrical test to check that no part of the unit is connected electrically to the grid or any of the photovoltaic panels.

Insulated gloves must be worn.

2. Assembly

CAUTION

The installation of Ingecon® Sun String Control must be performed by qualified personnel in compliance with the general safety instructions in this manual. The unit handles voltages and currents that can be dangerous.

CAUTION

If condensation or high humidity is detected inside the unit, it must be dried prior to any electrical connection.

The following paragraphs describe the actions to follow for proper installation of Ingecon® Sun String Control units.

2.1. Reception and unpacking

Reception

Upon receipt of the shipment, check the terms specified in the *Delivery Note*, sign the Signature Receiver Goods field and return the copy to the return address.

Packaging pallets with one or more crates with the following characteristics will be received:

Packaging	Weight, per crate (kg)	L/W/H/, per crate (mm)
Woodend pallet: Max. 8 crates	30	1450/600/400

Ingecon® Sun String Control units will be shipped in individual packages. Two horizontal boxes are placed on a europalet, and two more piled on top, up to four high, a total of eight boxes per europalet.

Moving the unit

The instructions for moving the unit are applicable for any movement from the time it leaves the factory.

Failure to observe these instructions may lead to loss of warranty on the product, for which Ingeteam Energy ,S.A. is not responsible.

Avoid bumps and rough handling.

Identifying the unit

The serial number (S/N) of the equipment is its unique identifier. This number must be quoted in any communication with Ingeteam Energy S.A.

Ingeteam		Avda. Ciudad de la Innovación, 13 31621 Sarriguren (Navarra) solar.energy@ingeteam.com Tel 948 288000 Fax 948 288001	
Ingecon® Sun String Control		IP 65	2010
Idc_{string}:	10 A	Udc:	405 - 1000 Vdc
S/N	16R100120A01		
Std:			

Transport damage

If the equipment has been damaged during transport:

- Do not proceed with the installation.
- Notify the distributor immediately within 5 days of receipt.

If ultimately the unit has to be returned to the manufacturer, you must use the same original packaging.

2.2. Location

Ingecon® Sun String Control units have an IP65 level of protection against external agents which enables them to be installed outdoors.

IP65 means that the unit is fully protected against the ingress of dust and also against water jets from any direction.

However, continued excessive moisture can damage the unit. Hence the following is recommended:

- Locate the units in a place protected from the rain.
- Avoid corrosive environments.
- The ambient temperature should be between -20 and 65 °C.

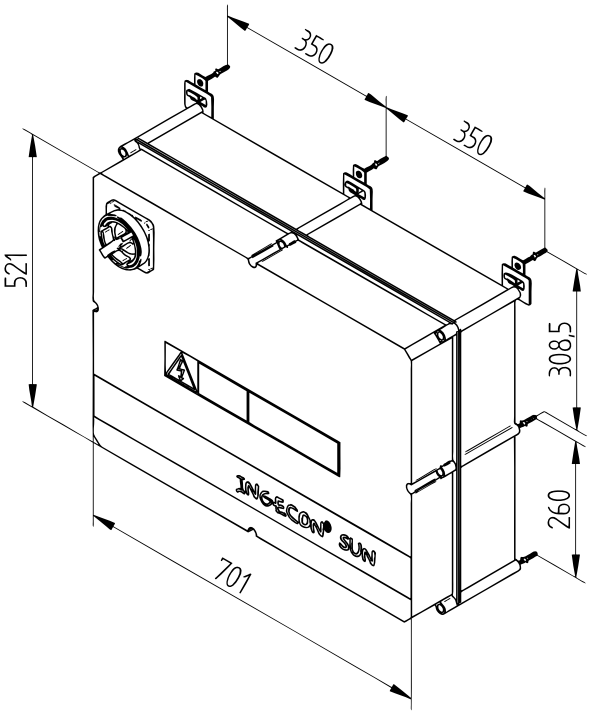
It is important for the unit to be located in a place readily accessible for installation and maintenance work, enabling access to the unit's various internal components and in compliance with the following requirements:

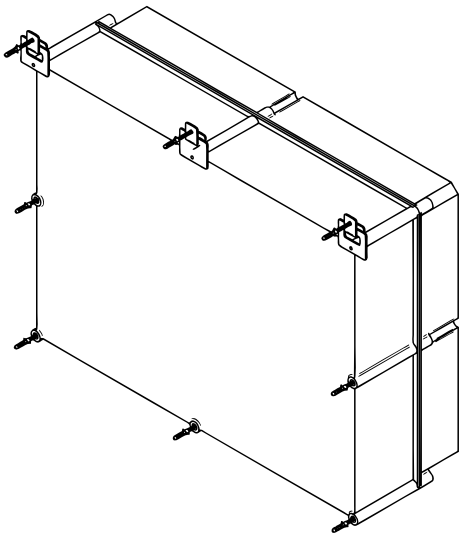
- The front of the unit should be accessible for carrying out handling tasks inside the unit.
- Connections must be at the bottom so that the connectors exit downwards.

Fixings

The Ingecon® Sun String Control units have a direct wall fixing system.

The system comprises eight screws, 60 mm in length, with 8 blocks 8 mm in diameter. These screws secure the cabinet via the 8 through holes on the cabinet's housing.





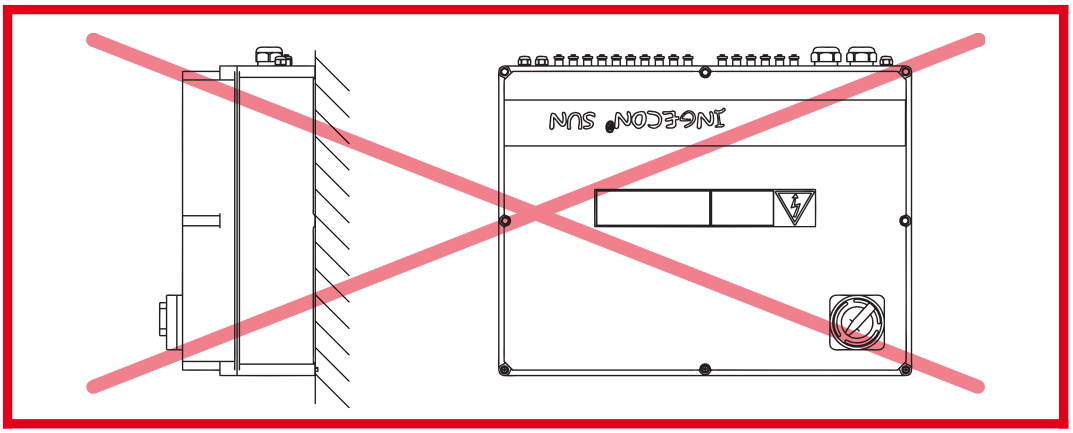
Orientation

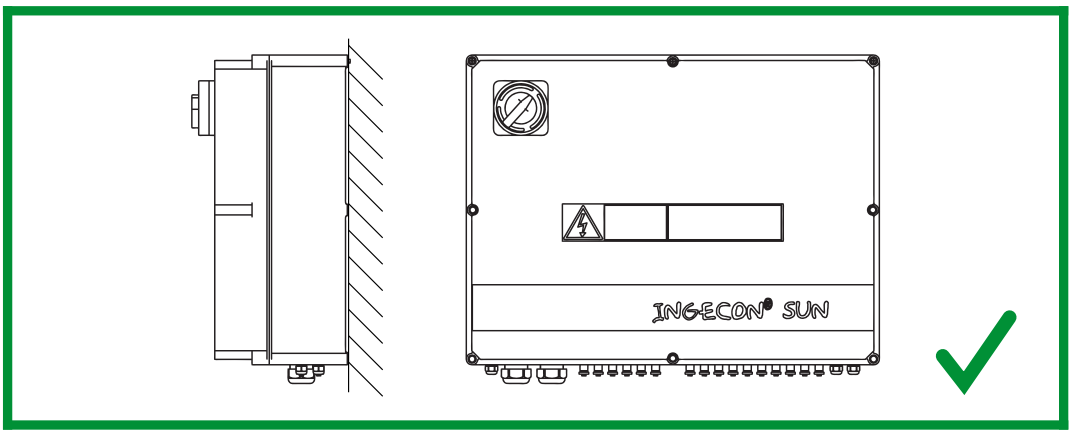
There is only one possible orientation for the unit. Wall-mounted, vertical installation with connectors facing downward.

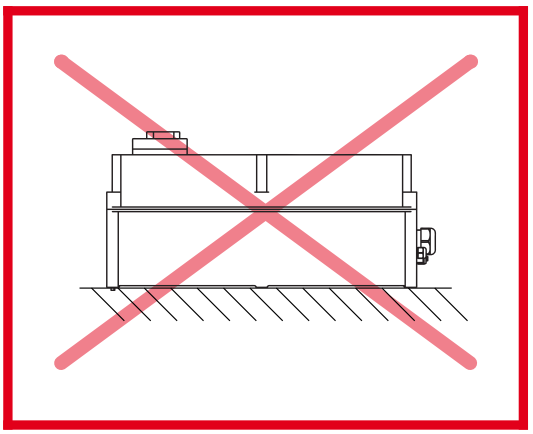
CAUTION

The unit must be installed as shown on the sticker on the unit's enclosure.

If the unit is installed contrary to Ingeteam Energy, S.A.'s instructions, the company assumes no liability for the consequences of this incorrect installation.







3. Electrical connection and disconnection

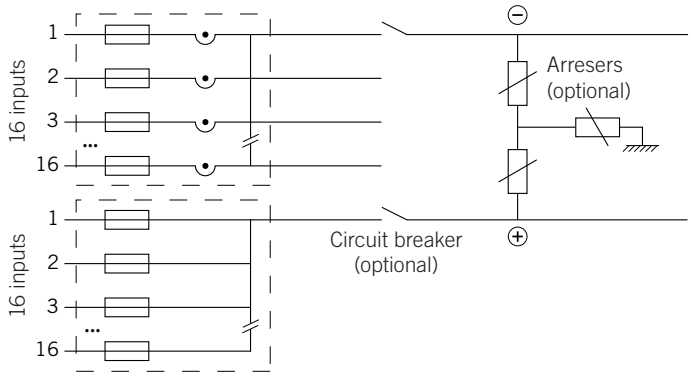
3.1. Connection

Once the unit is installed in its final location, proceed to carry out the electrical connections to auxiliary equipment and the PV array.

The electrical connection of the Ingecon® Sun String Control inverter must be performed by qualified personnel in compliance with the general safety instructions in this manual. The inverter handles voltages and currents that can be dangerous.

The basic connections to be made with the inverter are as follows, in this order:

1. Communication line (optional).
2. Ground connection if the unit includes arrester (via M16 cable gland).
3. Inverter connection (via M40 cable glands). See section “3.5. Inverter connection”.
4. Connect all Ingecon® Sun String Control (or similar units) associated with the inverter before proceeding with the installation of any of them.
5. Connect the PV array to each of the Ingecon® Sun String Control units associated with the same inverter. See section “3.6. Connecting to the PV array”.



3.2. Opening and accessing the equipment

Care must be taken to ensure the equipment is not live when accessing its interior.

Never open the top of a unit outdoors if it is raining or with chances of rain. Before opening the lid of the unit, clean the outside of the enclosure of dirt and moisture.

Care must be taken to ensure the equipment is not live when accessing its interior.

During inspection work:

The inspection work covers only visual tasks; never remove any protection element from live areas (terminal covers, polycarbonates, silicones, etc.).

For visual inspection tasks first open the box breaker, if it is installed, unscrew the 9 screws that secure the unit cover and remove it. Remember to keep a safe distance from live elements.

CAUTION

If there is a breaker kit, even with the breaker kit switched off, supply connection terminals to the inverter can be live with dangerously high voltages.

As long as the panels are exposed to the light, the DC cables will carry potentially dangerous voltage levels.

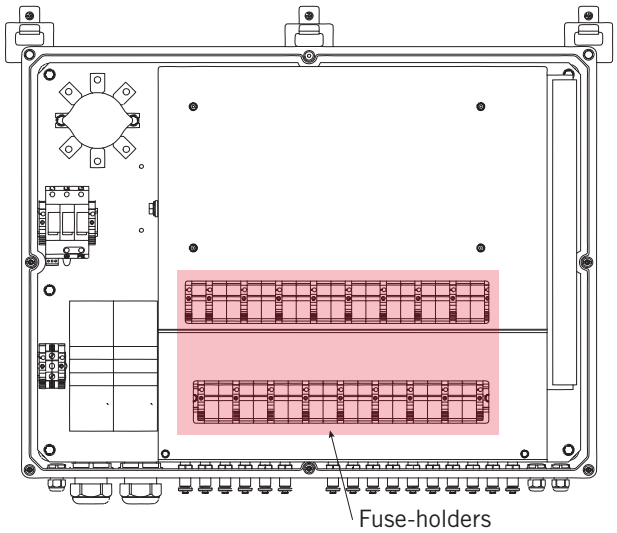
During handling work:

The front panel of the cabinet can only be opened when the connections both to the PV array and the inverter, the DC circuit breaker and any auxiliary external supplies are disabled.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

Remove all voltage sources from the unit: the grid, the PV array and any auxiliary power supply. Do it in the order described at the beginning of paragraph "3.7. Shutdown".

Once all sources of voltage are disconnected, remove the lid and open all fuse holders (both positive and negative poles).



CAUTION

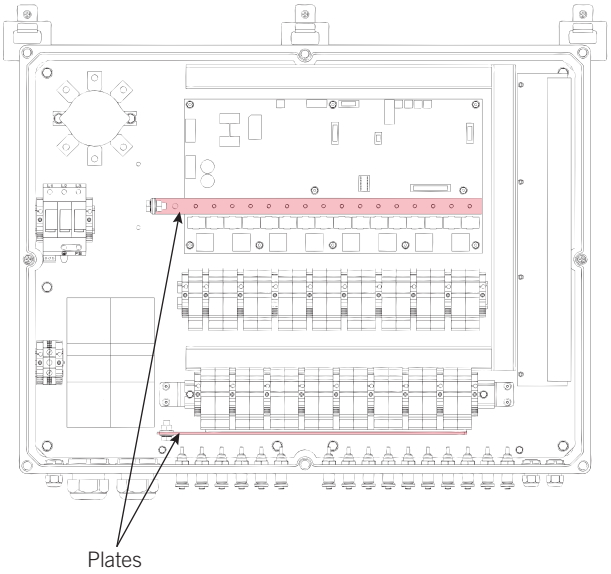
Never handle the fuses without having stopped the inverter. Fuses cannot be opened when live.

To access the electronics remove the polycarbonate protector.

Once the equipment is open, check there is no electrical hazard in the voltage inputs from the inverter, the PV array or any auxiliary supply.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

Proceed measuring voltage between the copper plates shown in the figure below.



Unit access

All cables enter the unit through cable glands and fast connectors located on the cabinet base, as shown in the following drawings.

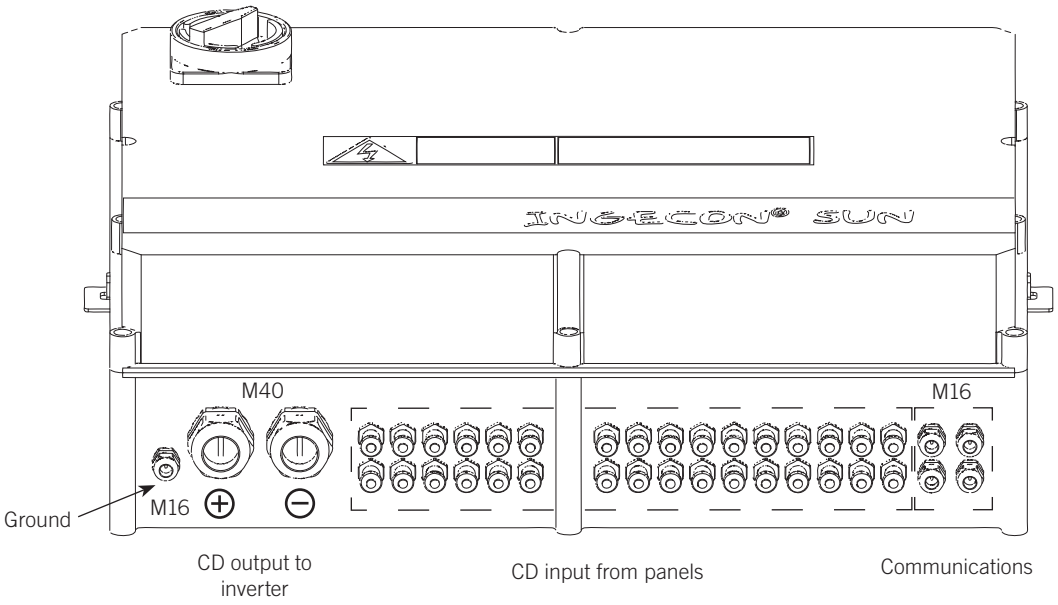
Gland M40 is suitable for cables with a diameter from 19 to 28 mm.

Gland M16 is suitable for cables with a diameter from 4.5 to 10 mm.

DC cables exit to the inverter via the two M40 glands. Cables used should have a maximum section of 240 mm2 with M12 ring-type terminal.

Communications, auxiliary inputs and earthing, in the event of having arresters, have access to the unit via the M16.

The inverter is connected to the PV array by means of quick connect terminals. For cables up to 6 mm2.



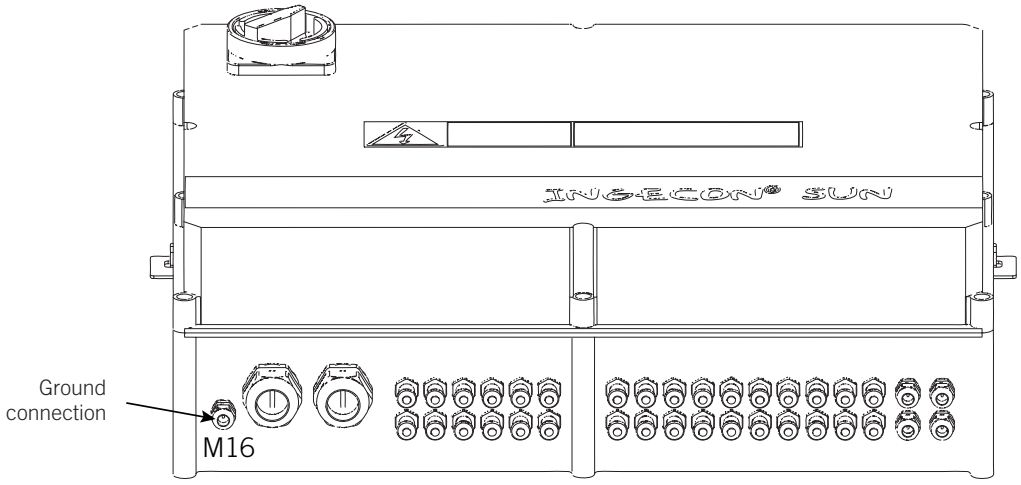
3.3. Ground connections

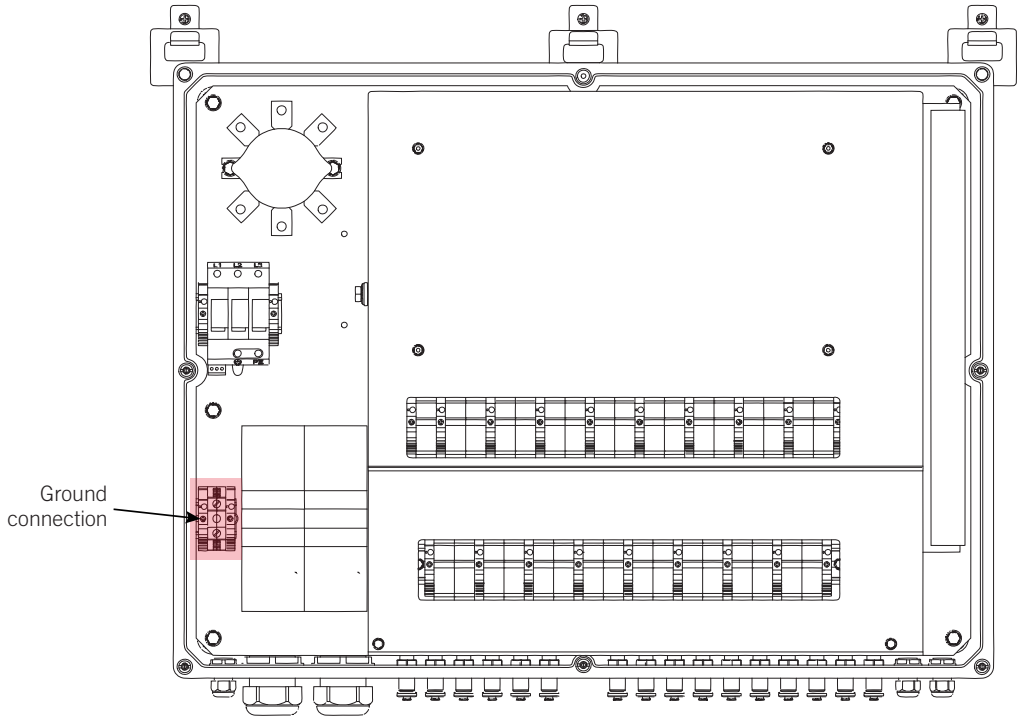
If the unit is supplied with an optional arrester kit, it is grounded. If not, it is not connected, and a plug is placed in the box instead.

Access through the gland located in the lower left, to the left of the DC outputs.

The connection is via a rod, coupled to a ground terminal screw.

The wire used for grounding must be at least 10 mm2 and at most 25 mm2.

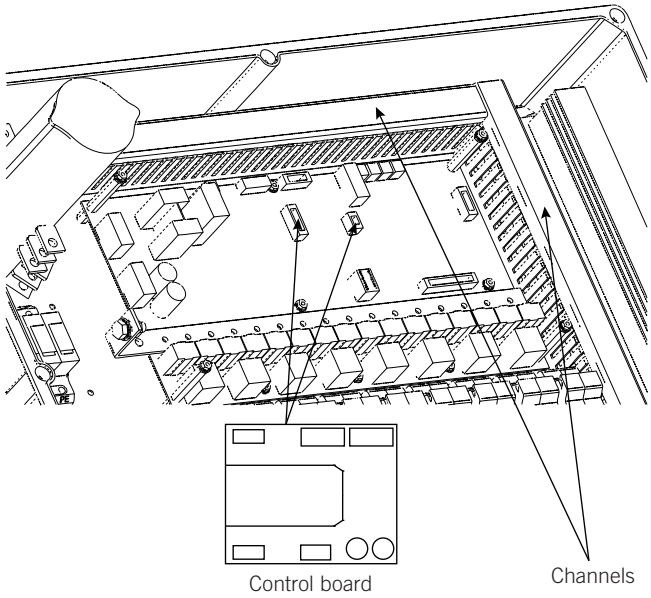




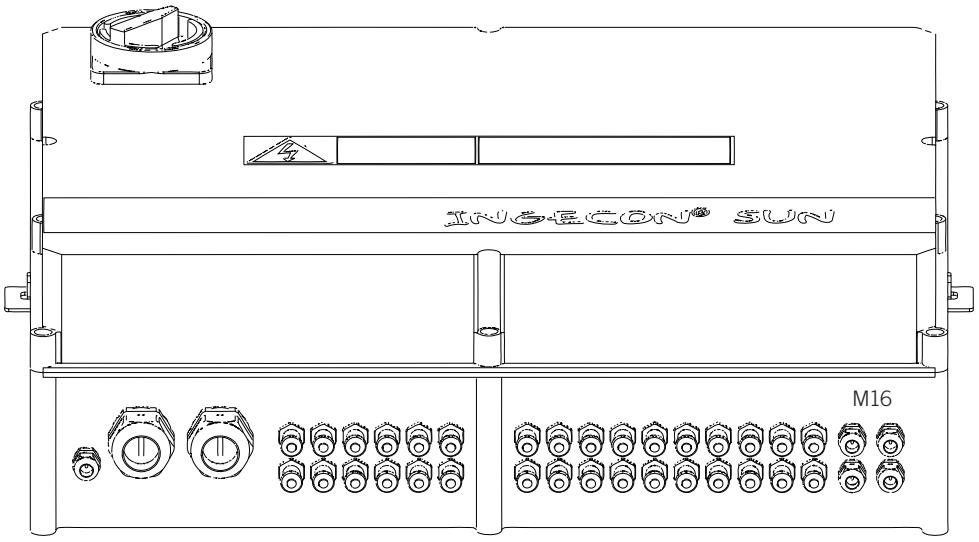
3.4. Connection for communication

Communication accessories GSM/GPRS Modem, RS-485 and optical fibre are connected to the Ingecon® Sun String Control unit in connectors J2 and J4.

Communication cables must pass through the ducts to exit the cabinet via the corresponding glands.



See "AAP2002IKH01 Installation Guide for Communications Devices" for further information.



Auxiliary communications and connections

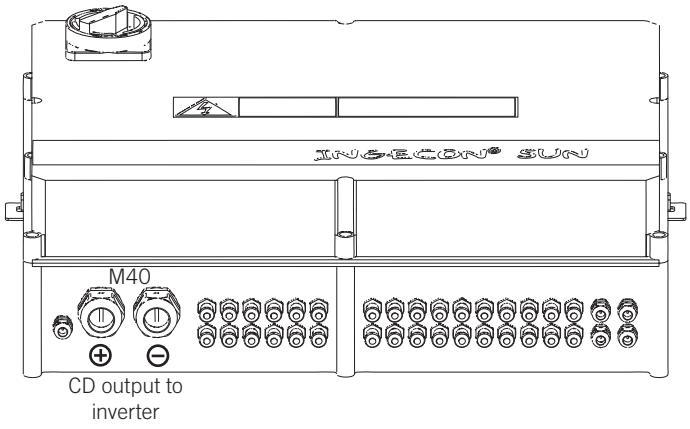
3.5. Inverter connection

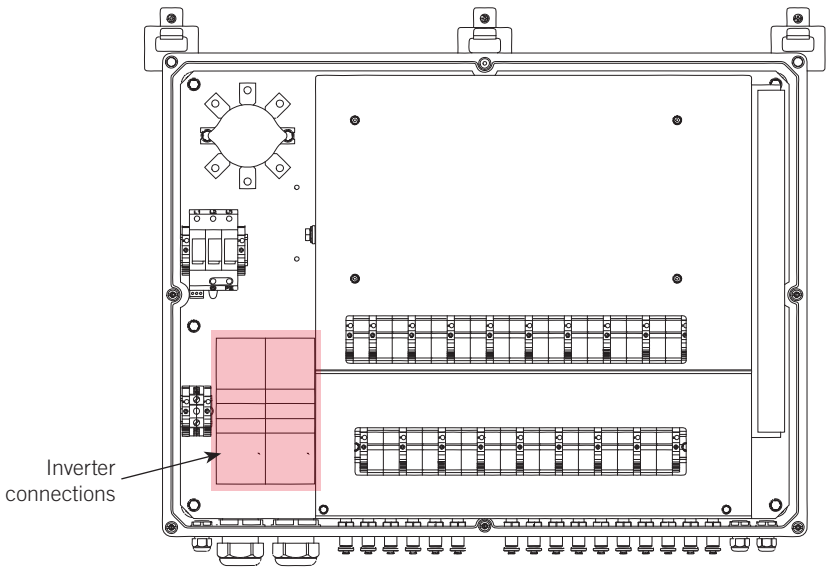
The cables for connecting the unit enter through the glands at the base of the cabinet. Maximum cable section is 240 mm2.

Before any handling, check that there is no electrical hazard in the voltage input in the inverter's DC voltage input.

When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

Never forget that when you connect the strings box to the inverter, the PV array must be disconnected and the inverter breaker must be open.





It is also important to check:

- Tightening torques for the screws, as indicated in paragraph "6.1. Maintenance tasks".
- Ensure that the gland is well sealed.

3.6. Connecting to the PV array

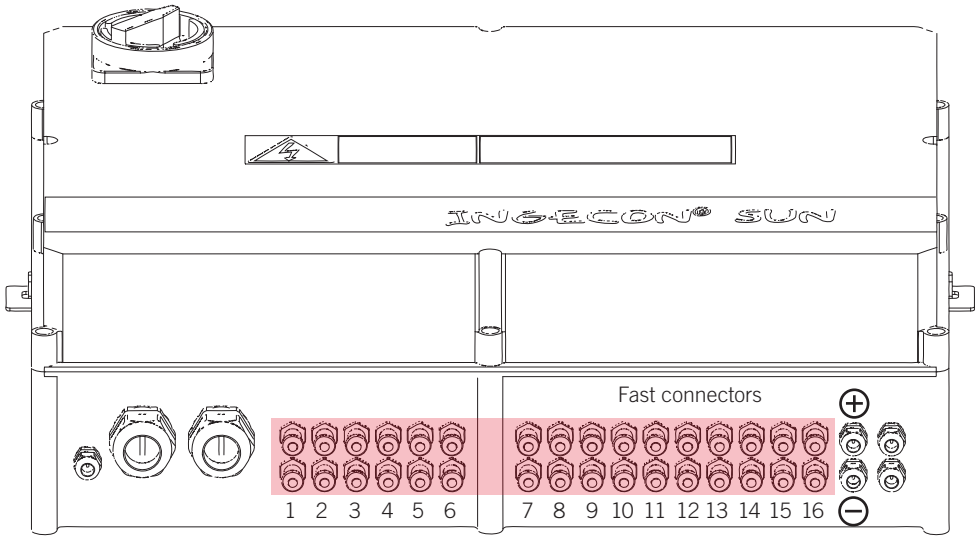
The cables for connecting the unit to the PV array enter through the fast connectors in the base of the cabinet.

Never forget that whenever they receive solar radiation, the panels' terminals generate voltage.

The strings box may have voltages of up to 1000 volts inside.

CAUTION

Connect the positive pole of the panel series to the terminals on the top row, and the negative pole to the terminals on the lower row.



3.6.1. Reverse connection of a PV array

CAUTION

The reverse connection of a PV array string would have fatal consequences for the Ingecon® Sun String Control unit and would cause serious damage to persons in the surroundings of the unit.

CAUTION

The reverse connection of a PV array string generates a short circuit, causing an overcurrent in the reverse-connected string. The fuse associated with this string will clear this short-circuit. The voltage to open the fuse will be twice the open circuit voltage, due to having connected the string backwards.

Always check the polarity of the PV arrays before making any connections.

Special attention should be paid on first installation of the various strings of the PV array to the Ingecon® Sun String Control (diagram 1) and of the various Ingecon® Sun String Control units to the inverter (diagram 2).

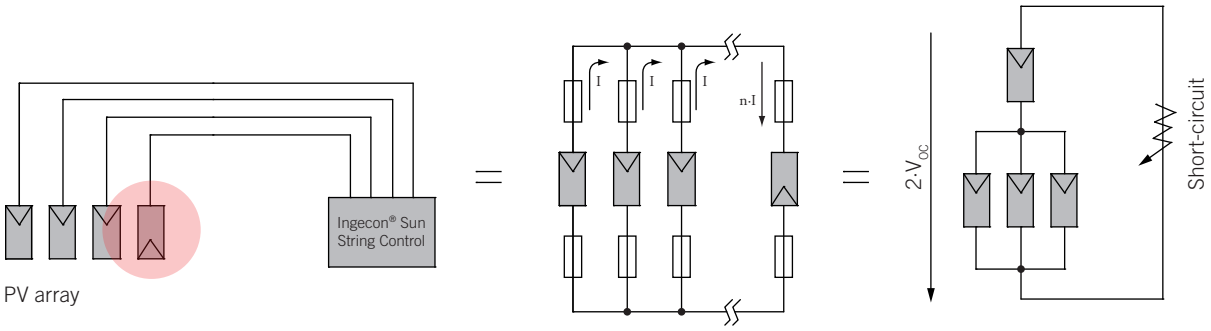


Diagram 1

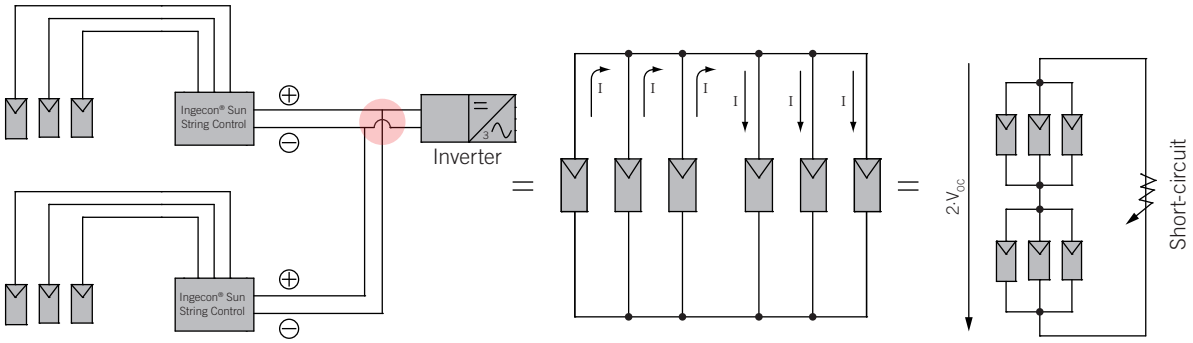
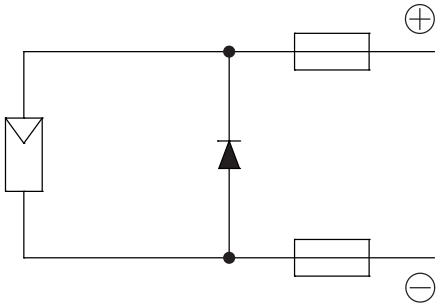


Diagram 2

To avoid the overvoltage problem caused when a string is connected in reverse, Ingeteam Energy, S.A. implements a patented system. When connecting a string backwards, a protection diode conducts to ensure that the voltage inside the enclosure is within safety margins.



If the string is polarised backwards, the diode conducts the current generated by the string, short-circuiting it. At the moment of installing the strings in the cabinet, all fuse holders should be open with the fuses removed. You must connect the strings to each other and check with a multimeter that they have the open circuit voltage and if possible measure the current flowing through them. If there is current or if the voltage is very different from the open circuit voltage, proceed to disconnect the string from the Ingecon® Sun String Control safely.

CAUTION

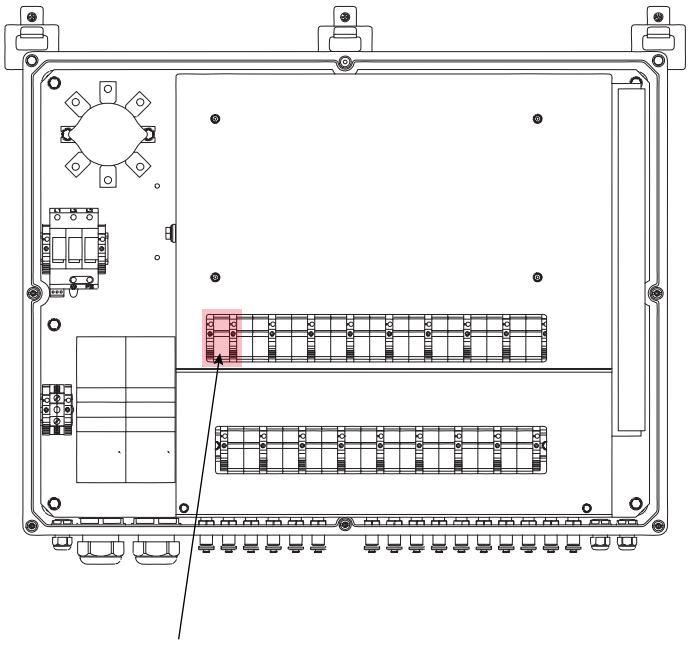
Ingecon® Sun String Control supports a maximum of two reverse-connected strings. If more than two strings are connected in reverse the unit would be destroyed.

3.6.2. Procedure for connecting the PV array for the first time

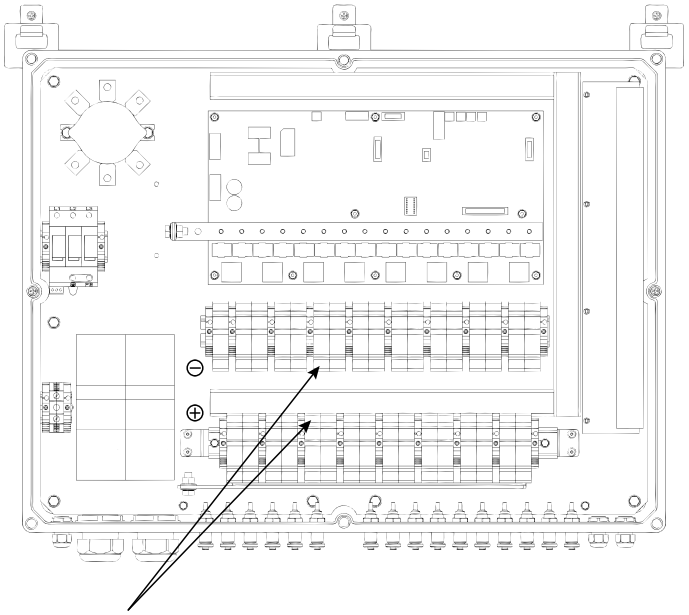
CAUTION

Before connecting the PV array to all Ingecon® Sun String Control units connected to a single inverter, you must follow the following procedure

1. Open the switch (if any) and remove the cover to access the interior of the Ingecon® Sun String Control.
2. Open all fuse holders in the positive and negative poles and remove the fuses.
3. Leave the fuse that protects the electronics supply closed.



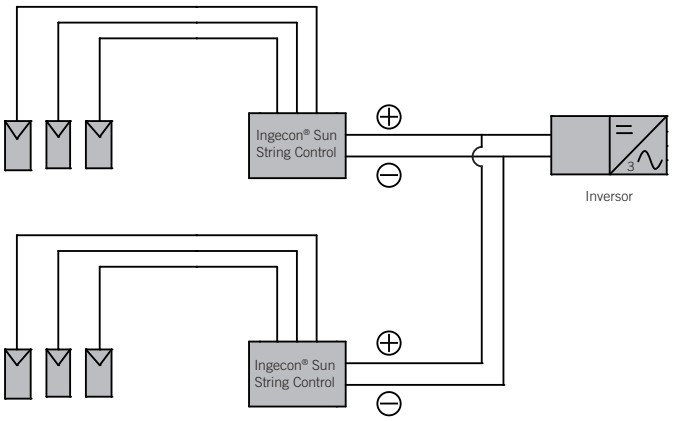
4. Repeat this action with all Ingecon® Sun String Control units connected to a single inverter.
5. With the fuse holder open, connect a string. Before connecting any further strings, perform the checks shown in the following points.
6. Using a multimeter suitable for the VOC of the PV array, measure the voltage between the inputs of the fuse holders and check that the voltage polarity and value are correct (with the PV array connected).

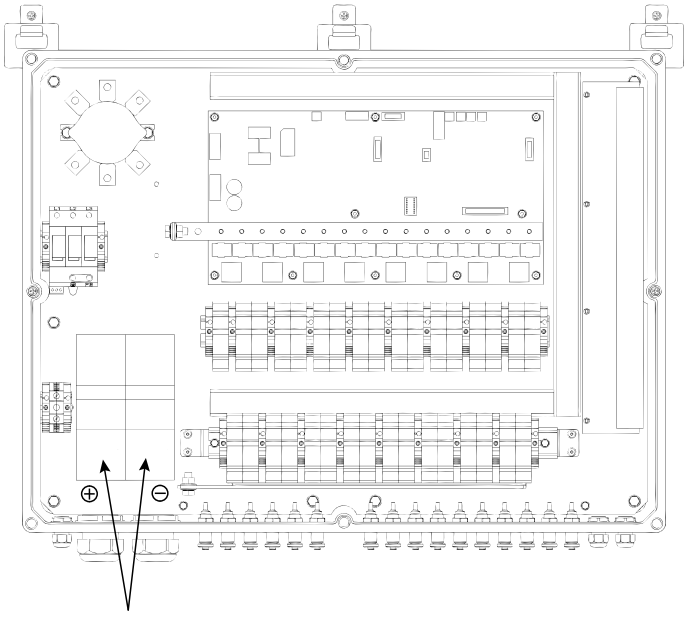


Measuring point

- If the voltage is the expected VOC, continue with the next string.
- If the voltage is near zero, check that the string has been installed with the correct polarity, taking care to open the string safely.
- If the voltage is not as expected, check the installation.

7. Repeat steps 5 and 6 for all the strings attached to the Ingecon® Sun String Control.
8. Do not insert the fuses or close the fuse holders.
9. Repeat steps 5, 6, 7 and 8 for all the Ingecon® Sun String Control units connected to the same inverter.
10. Insert a couple of fuses, positive and negative, in a string box. Close those fuse holders and switch, if any. The inverter's feed wiring will be live. Check the polarity of positive and negative terminals in the rest of the string box to prevent reverse connections between boxes.





Polarity checking points

11. If the polarity is correct, proceed to insert the fuses in the remaining strings and close all the fuse holders.
12. Close all boxes and switches, if you are setting up this option.

3.7. Shutdown

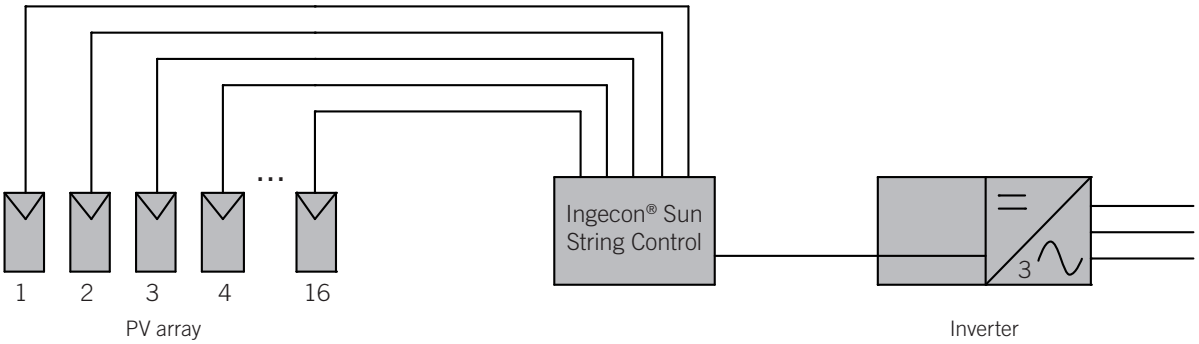
This section will describe how to disconnect the unit temporarily for maintenance operations, for example.

All maintenance operations carried out on the unit should be performed voltage-free, understanding voltage-free work as described in Royal Decree 614/2001 for electrical work.

The first 5 steps (the so-called 5 golden rules explained in section "1.2. General safety precautions") to achieve a voltage-free work situation, is to shutdown the units, which should be done in a predefined order depending on the number of Ingecon ® Sun String Control units you have connected to the same inverter.

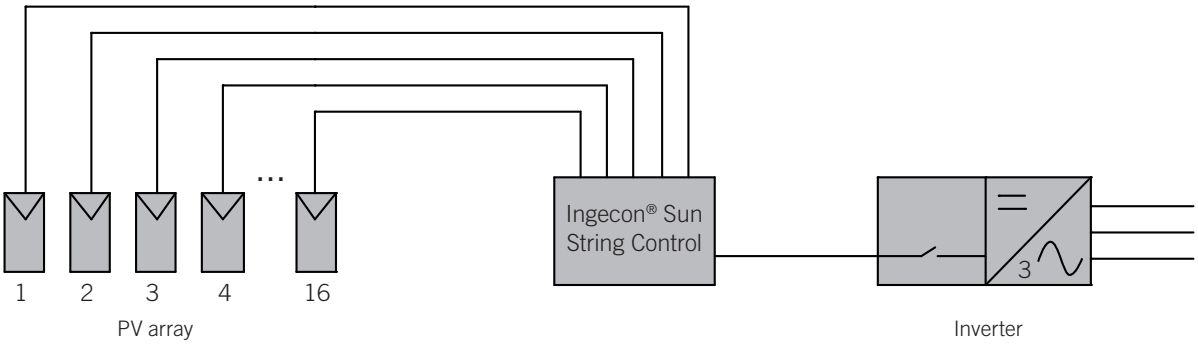
3.7.1. Inverter with an Ingecon® Sun String Control unit

The normal operating diagram is as follows:

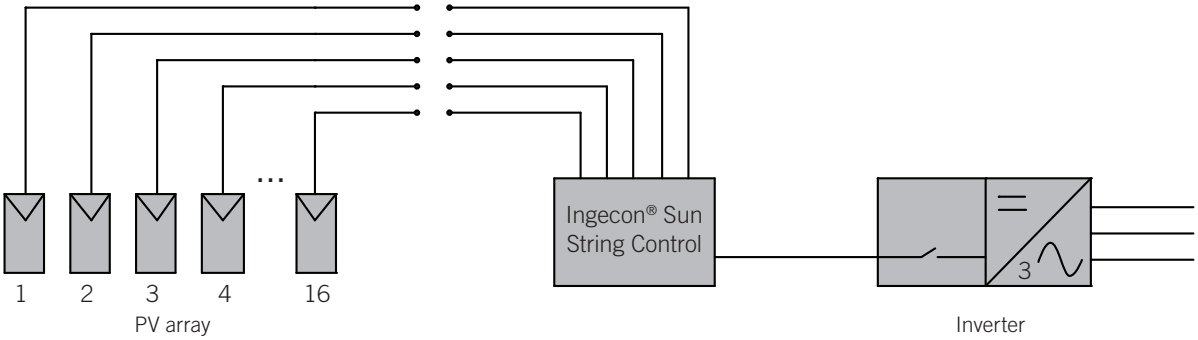


To disconnect the unit, follow these steps:

1. Stop the inverter (via the emergency stop button or manual stop) and open the DC and AC breaker.



2. Disconnect the PV array

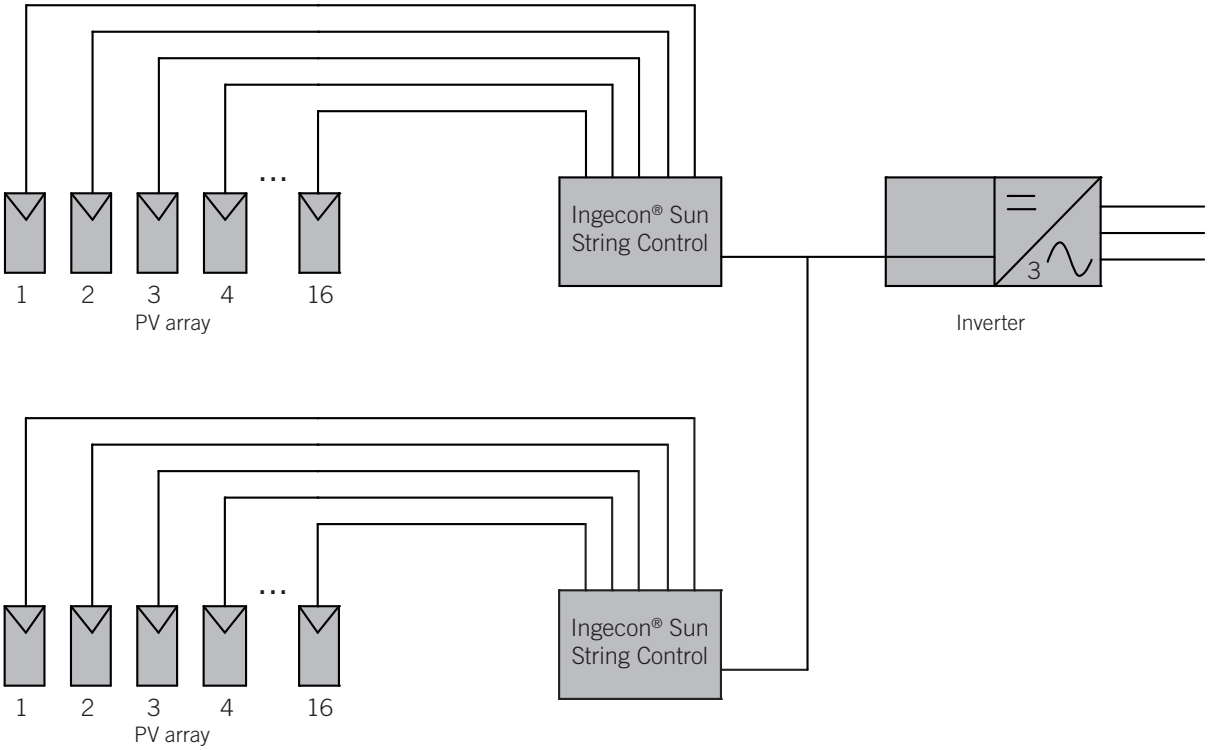


3. Voltage-free cabinet
4. Disconnect the entire PV array associated with the unit.

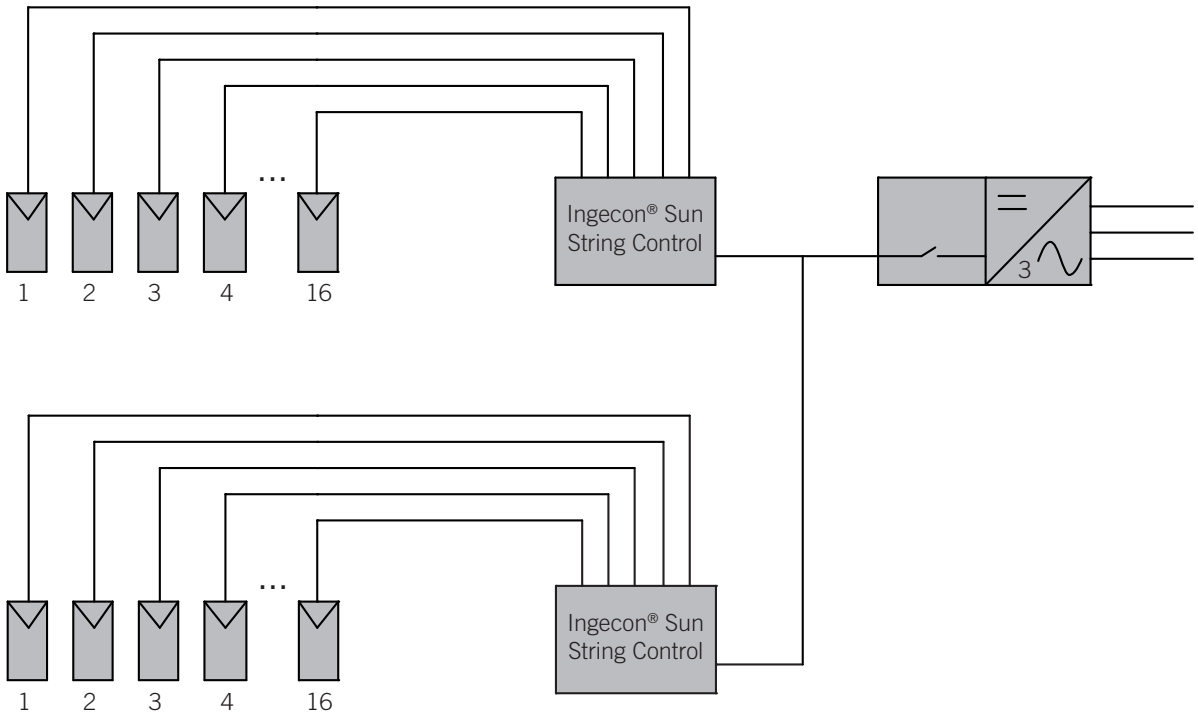
3.7.2. Inverter with more than one Ingecon® Sun String Control unit

In the following example we will see shutdown with two Ingecon® Sun String Control units. If you have more than two Ingecon® Sun String Control units, the shutdown process would be the same, involving the operations described below for each unit.

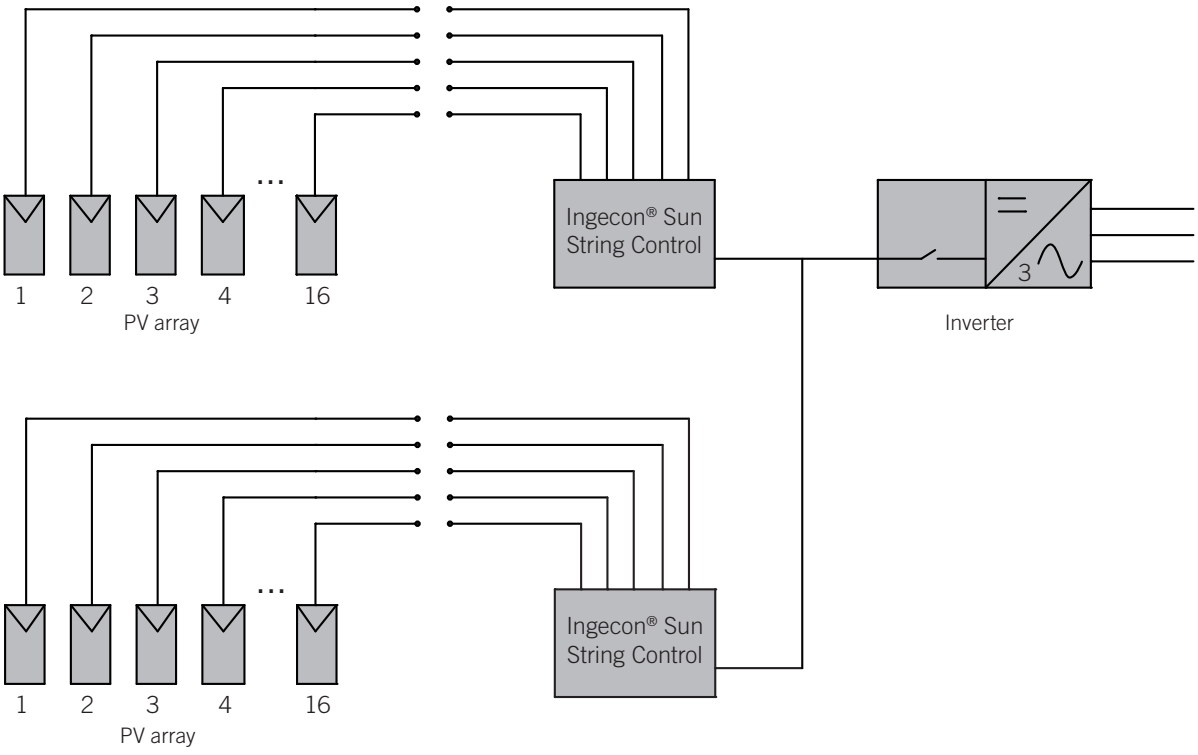
The normal operating diagram is as follows:



1. Stop the inverter (via the emergency stop button or manual stop) and open the DC and AC breaker.



2. Disconnect the PV array from all cabinets



3. Voltage-free cabinets
4. Disconnect the entire PV array associated with the unit.

3.8. Shutting down

During installation, make sure that the protection grade of the equipment has not been altered.

In all connections through cable glands, give cabling enough length inside the unit so they don't pull on the internal electrical connection terminals.

Ensure that unused glands have been duly replaced with plugs.

Ensure that the front cover is securely closed, that it fits within the perimeter and that the eight fasteners are tightly bolted down.

Reconnection

If you need to reconnect the unit, follow these steps: Keep in mind that in these instructions we refer to the steps to be taken for reconnecting a fully installed unit.

1. Replace the protective polycarbonate element if it has been removed.
2. Close fuse holders in the positive and negative poles if they have been opened.
3. Visually inspect the interior of the unit to ensure that there is no foreign particles inside.
4. Close the enclosure if it has been removed.
5. Disconnect the PV array from the unit.
6. Connect the rest of the PV array connected to the inverter associated with the unit.
7. Close the inverter's DC switch.
8. Remove emergency stop button and change to "On" on the display.

Safety measures

Observe the requirements already explained prior to connection.

The front door should be opened only after disconnecting the unit from the inverter and its PV array.

It is also essential to close the unit before connecting it to the PV array or the inverter.

Do not alter the position of the DC breaker or connect cables with the door open. do not operate the controls on the door nor apply force to the internal electrical devices which they control.

4. Start-up

The string box may be started up only after all connections described in the previous sections have been made and the unit is perfectly closed.

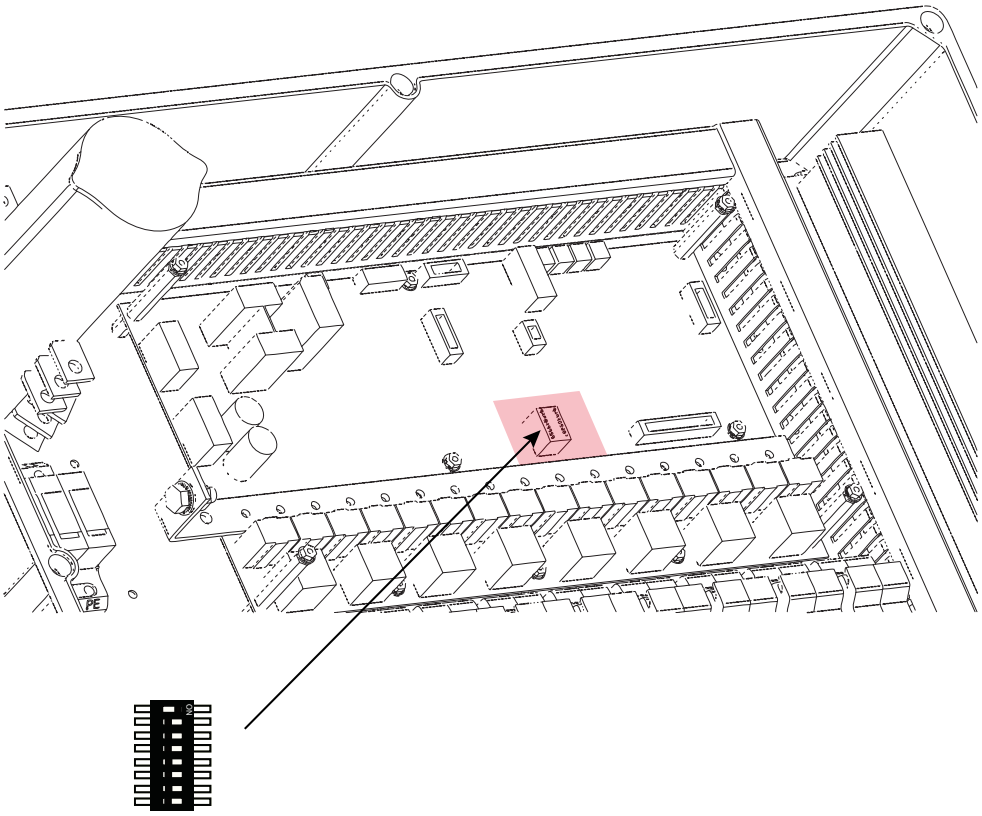
4.1. Electrical contact with the inverter and PV array

Establish the electrical connections following the instructions in the sections on connecting to the inverter and the PV array.

4.2. Configuration

Before making any connections in the Ingecon ® Sun String Control, proceed to assign a node number. This number can never be the same as the node number of the inverter unit.

The connection is made through switch 1 (SW 1). This is an 8-channel switch with which we can configure the node number (see "Appendix A: Encoding for Strings").

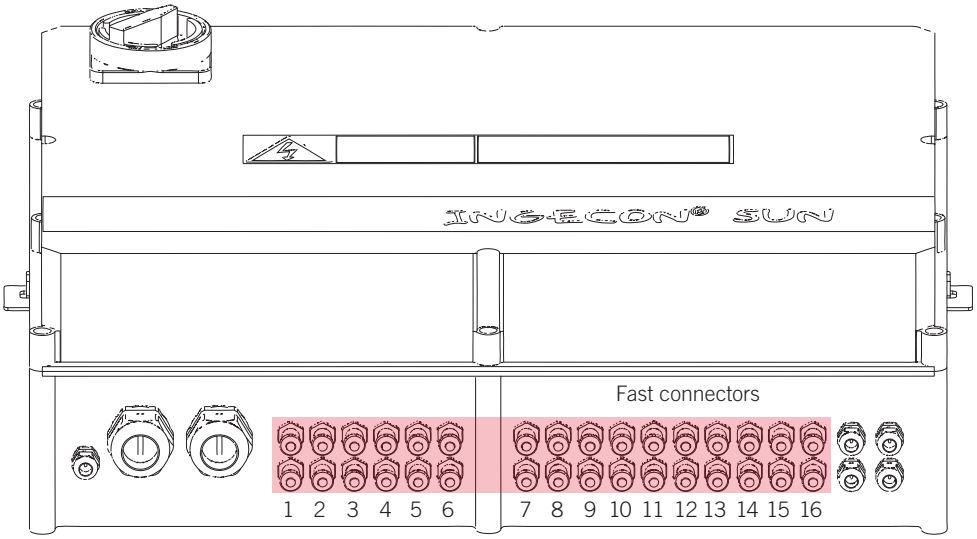


There should never be same-numbered nodes (inverters or other identical units) within the same communication bus.

The Ingecon ® Sun String Control unit can and must be configured via the Ingecon® Sun Manager software.

The most important configuration parameters are as follows:

- Number of strings installed the number of strings connected to the unit. Remember that strings should be plugged into the lowest numbered connectors (from left to right). By default, the number of strings is 16.



- Rated current for each string: Use this field to input the nominal value of each string's current in amperes. By default they are set to 10 A.

- % mean deviation: the percentage of deviation between the current of each string and the average of the currents in the unit for which an alarm is to be obtained.

- Time before alarm: the time during which a string must indicate a current above the average deviation percentage before the unit generates an alarm. Defined in a matter of seconds.

- Light detection: a function that can be enabled or disabled. When this feature is selected, if light is detected inside the unit (for example, an improperly sealed cover), the system triggers an alarm and closes a potential-free relay.

- Sending of shutdown command frame: a function that can be enabled or disabled. If both this function and the light-sensing function are active, a shutdown command is issued via communication to the inverter associated with the Ingecon® Sun String Control unit when there is a detection of light inside the unit.

- Node of the inverter associated to the Ingecon® Sun String Control: the inverter's communication node to which the Ingecon® Sun String Control unit is connected. The default value is zero, so that when light is detected inside the cabinet a shutdown command would be sent to all inverters connected to the communication network.

4.3. Operation

The Ingecon® Sun String Control is multi-functional. First, it serves as a string grouping box where up to 16 PV array strings can be put in parallel. Secondly, it includes a number of fuses and fuse holders to protect the system and allow isolation (fuse holders should never be opened when live) of the PV array. Lastly, the unit takes readings of the currents provided by each string and triggers an alarm in the event that a string has an anomalous current and providing information on the output of each string.

When the inverter starts up and injects power into the grid, the PV array current goes through the Ingecon® Sun String Control inverter. This unit begins to measure the currents that pass through each string, compares them and detects whether there is an out-of-range current.

Anomalous current detection

Periodically, the unit measured each string and calculates the average current of all active strings, weighing them by their rated current. Then you calculate the deviation of each string with respect to this weighted average. If the deviation of any of the strings exceeds the percentage specified in the configurable % average deviation parameter, then we consider that the string has an anomalous current. If this string's current remains above the average % deviation for longer than the time before the alarm, the unit triggers an anomalous current alarm.

The process for detecting anomalous current begins when the average current exceeds the greater of two values: 0.5 A or 10% of the rated current of the strings. This is done to filter alarms in times of very low irradiance or during sunrise and sunset.

Blown fuse detection

This team does not have a blown fuse detection hardware but rather evaluates the currents and under certain circumstances determines that there is a possibility of a fuse being blown.

The unit believes that a string has a blown fuse when it does not exceed 200 mA while the average for the rest of the unit exceeds the greater of two values: 1 A or 20% of the rated current of the system.

As can be deduced from these conditions, the unit assumes that a fuse may be blown when the corresponding string has zero current (with a safety margin) and the rest of the system is in production. Thus it may be that this fault is not due to a blown fuse but a connector not making good contact, a broken wire in the system, etc.

Light detection

The detection of light is an option that may be enabled or disabled. The unit features a light detector on the inside. When the light detection option is enabled, if the unit detects a certain amount of light inside, it triggers an alarm and closes a potential-free relay associated with terminal J23. This relay allows opening or closing a signal of up to 230 Vac and 3 A.

When, in addition to the light detection function, the shutdown command is activated, if the unit detects light in its interior, it sends a shutdown command to the associated inverter. This way, no current passes through the unit and potential damage is minimised if the Ingecon ® Sun String Control enclosure is not properly closed or left open.

When this option is selected, the node number of the inverter to which the Ingecon® Sun String Control inverter is connected must also be configured.

When the Ingecon ® Sun String Control with the shutdown command frame option active detects light above the allowed threshold, it sends a continuous stream of shutdown commands to the inverter. These commands collapse the communication bus and communication will not be possible with any node in the same communication bus as long as the light detection alarm is on.

If the node number of the inverter is node 0, the Ingecon® Sun String Control unit will issue a shutdown command to all inverters connected to the same communications bus. This is why it is recommended to configure this field with

the appropriate inverter number

5. Uninstalling

To uninstall the unit, follow these steps:

1. Press emergency stop button or stop the PV inverter connected to the corresponding Ingecon® Sun String Control.
2. Open the inverter's DC breaker.
3. Wait 10 minutes to allow internal capacitances to discharge.
4. Disconnect the unit's PV array
5. Disconnect the entire PV array associated with the inverter to which the unit is connected (see section "3.7. Shutdown").
6. Open the unit and check that there is no voltage (See section "3.1. Connection").
7. Disconnect the following cables:
   - Communications line.
   - Inverter connection.
   - PV array connection. See section "3.6. Connecting to the PV array"
   - Grounding connection. See Section "3.3. Ground connections".

Take careful note of the following warning:

Conduct an electrical test to check that neither the no part of the unit is connected electrically to the grid or any of the photovoltaic panels. When checking that there is no voltage, wearing dielectric gloves and safety goggles approved for electrical hazards is required.

And remember:

Ingecon® Sun String Control units may only be opened by qualified personnel.

For all installation, commissioning and maintenance work, personal protective equipment (PPE) must be worn:

- Helmet.
- Dielectric gloves suitable for the operating voltage.
- Gloves for protection against mechanical hazards.
- Safety goggles approved for electrical hazards.
- Safety footwear.

Installation work requiring opening the unit should be done in a dry environment, so that no moisture left inside could condense and damage the electronics.

Never open it in a humid atmosphere.

Ingeteam Energy, S.A. is not liable for any damages caused by improper use of its equipment.

Disposal

At the end of the unit's life, the waste must be processed by an authorised waste management company.

Ingeteam Energy, S.A. is not liable for any damages caused by improper use of the equipment. Any work carried out which implies a modification of the original electrical settings must be consulted in advance with Ingeteam.

Current environmental legislation and any client requirements must be complied with in all actions performed. Close attention should be paid to the handling of hazardous materials and proper waste separation.

6. Preventive maintenance

Preventive maintenance tasks recommended are to be carried out annually.

The various maintenance tasks must be performed by qualified personnel. Danger of electric shock.

To access the various compartments, take into account the safety recommendations in Section “1.2. General safety precautions".

All maintenance checks listed here should be done with **no voltage on the inverter** and in safe conditions for handling.

6.1. Maintenance tasks.

Check status of the enclosure

A visual check of the status of the enclosure must be performed, verifying the status of locks, doors and handles and the unit fixings at both lower and, if any, upper anchorage points. In addition, the condition of the enclosure must be checked for dents, scratches or rust that might degrade the cabinet or cause it to lose its protection classification. If this type of defects are noticed, the parts affected must be substituted.

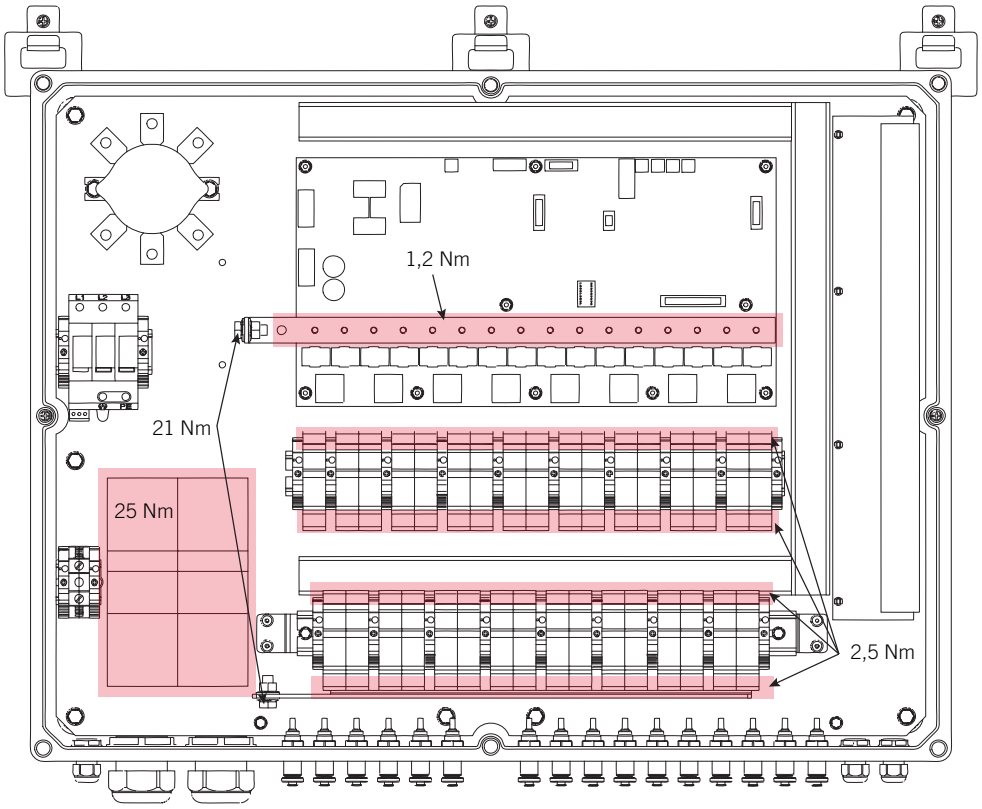
Check the status of the cables and terminals

- Check the correct path of the cables so they do not come into contact with live parts.
- Check for insulation faults and hot spots by checking the colour of the insulation and terminals.
- Check that the glands are properly sealed and tightened.
- Check the proper status of cables to the input terminals (green terminals) of the string measurement card. To do this, check that each is properly inserted with the tip on the inside.
- Check the torque (2.5 Nm) of the screws of all fuse holders, two in each.
- Check the proper condition and tightness of the screws holding the negative plate to the string measurement card (1.2 mN).
- Check tightness of output terminals XDC+ and XDC-. To do this, lift the terminal cover and apply a force of 25 mN.

Check that there is no moisture inside the cabinet.

If moisture exists, dry before making electrical connections.

Check the correct fixing of the cabinet components to their corresponding anchorage points.



7. Troubleshooting

This is a guide for troubleshooting problems that may arise in the installation of the Ingecon® Sun String Control unit.

Troubleshooting for the Ingecon® Sun String Control unit must be performed by qualified personnel in compliance with the general safety instructions in this manual.

Ingecon® Sun String Control not responding

There can be various reasons for communication faults in the Ingecon® Sun String Control. Check the following:

- The communication wiring is properly connected.
- The communication node is properly configured.
- That no two or more devices with the same communication node exist on the network.
- Communication card is properly configured.
- The type of communication is correct, namely Modbus RTU 8-bit, no parity, 1 start bit and 1 stop bit.
- The unit is properly powered, check if the protection fuse of the source has not blown.

Light alarm

If the Ingecon® Sun String Control unit light displays a light alarm, check the system to ensure the correct assembly of the same. The box must be installed vertically, with the connectors on the bottom, as shown in section "2.2. Location".

Check that the cover is properly closed with the seals closed tightly in place.

Check cable inputs. All of them must enter through the glands, which must be properly sealed to prevent water and light from filtering in.

Ingecon® Sun String Control damaged in the diode area

If strings are installed incorrectly, as shown in section "3.6.1. Reverse connection of a PV array" there is risk of harm.

The diodes withstand a transient current to avoid dangerous electrical arcs. After installing the strings, you should always check that there is no current flowing in the diodes.

Water input

If during maintenance work water is found in the Ingecon® Sun String Control unit, proceed to dry it. The enclosure should be checked to pinpoint the water point of entry and proceed to sealing it.

Battery alarm

If the battery alarm appears in the Ingecon® Sun String Control, changing the battery is advised.

The alarm going off does not mean that unit data will be lost.

The battery model is CR2032.

7.1. List of alarms and stop reasons

The following tables detail the possible reasons for each alarm.

General alarms

This variable indicates general alarms in the string box.

Code	Alarm	Description
0x0001	Anomalous current alarm	Anomalous current in one of the strings
0x0002	Arrester alarms	Arrester alarm
0x0004	Fuse alarm	Blown fuses
0x0010	CI temperature alarm	High CI temperature
0x0040	Light detection alarm	Loss of IP protection
0x0080	Low battery alarm	Low battery in RTC
0x1000	Manual shutdown	Manual shutdown

Anomalous current alarm

This variable indicates which of the 16 series has an insulation fault.

Code	Alarm	Description
0x0001	Unexpected current alarm in series 1	Unexpected current in series 1
0x0002	Unexpected current alarm in series 2	Unexpected current in series 2
0x0004	Unexpected current alarm in series 3	Unexpected current in series 3
0x0008	Unexpected current alarm in series 4	Unexpected current in series 4
0x0010	Unexpected current alarm in series 5	Unexpected current in series 5
0x0020	Unexpected current alarm in series 6	Unexpected current in series 6
0x0040	Unexpected current alarm in series 7	Unexpected current in series 7
0x0080	Unexpected current alarm in series 8	Unexpected current in series 8
0x0100	Unexpected current alarm in series 9	Unexpected current in series 9
0x0200	Unexpected current alarm in series 10	Unexpected current in series 10
0x0400	Unexpected current alarm in series 11	Unexpected current in series 11
0x0800	Unexpected current alarm in series 12	Unexpected current in series 12
0x1000	Unexpected current alarm in series 13	Unexpected current in series 13
0x2000	Unexpected current alarm in series 14	Unexpected current in series 14
0x4000	Unexpected current alarm in series 15	Unexpected current in series 15
0x8000	Unexpected current alarm in series 16	Unexpected current in series 16

Fuse alarms

This variable indicates which of the 16 series has a blown fuse fault.

Code	Alarm	Description
0x0001	Fuse failed alarm in series 1	Fuse failed in series 1
0x0002	Fuse failed alarm in series 2	Fuse failed in series 2
0x0004	Fuse failed alarm in series 3	Fuse failed in series 3
0x0008	Fuse failed alarm in series 4	Fuse failed in series 4
0x0010	Fuse failed alarm in series 5	Fuse failed in series 5
0x0020	Fuse failed alarm in series 6	Fuse failed in series 6
0x0040	Fuse failed alarm in series 7	Fuse failed in series 7
0x0080	Fuse failed alarm in series 8	Fuse failed in series 8
0x0100	Fuse failed alarm in series 9	Fuse failed in series 9
0x0200	Fuse failed alarm in series 10	Fuse failed in series 10
0x0400	Fuse failed alarm in series 11	Fuse failed in series 11
0x0800	Fuse failed alarm in series 12	Fuse failed in series 12
0x1000	Fuse failed alarm in series 13	Fuse failed in series 13
0x2000	Fuse failed alarm in series 14	Fuse failed in series 14
0x4000	Fuse failed alarm in series 15	Fuse failed in series 15
0x8000	Fuse failed alarm in series 16	Fuse failed in series 16

Appendix A: Encoding for Strings

The following pages show the coding to be used to designate the various possible node numbers.

Node No.	8	7	6	5	4	3	2	1
1	Off	Off	Off	Off	Off	Off	Off	On
2	Off	Off	Off	Off	Off	Off	On	Off
3	Off	Off	Off	Off	Off	Off	On	On
4	Off	Off	Off	Off	Off	On	Off	Off
5	Off	Off	Off	Off	Off	On	Off	On
6	Off	Off	Off	Off	Off	On	On	Off
7	Off	Off	Off	Off	Off	On	On	On
8	Off	Off	Off	Off	On	Off	Off	Off
9	Off	Off	Off	Off	On	Off	Off	On
10	Off	Off	Off	Off	On	Off	On	Off
11	Off	Off	Off	Off	On	Off	On	On
12	Off	Off	Off	Off	On	On	Off	Off
13	Off	Off	Off	Off	On	On	Off	On
14	Off	Off	Off	Off	On	On	On	Off
15	Off	Off	Off	Off	On	On	On	On
16	Off	Off	Off	On	Off	Off	Off	Off
17	Off	Off	Off	On	Off	Off	Off	On
18	Off	Off	Off	On	Off	Off	On	Off
19	Off	Off	Off	On	Off	Off	On	On
20	Off	Off	Off	On	Off	On	Off	Off
21	Off	Off	Off	On	Off	On	Off	On
22	Off	Off	Off	On	Off	On	On	Off
23	Off	Off	Off	On	Off	On	On	On
24	Off	Off	Off	On	On	Off	Off	Off
25	Off	Off	Off	On	On	Off	Off	On
26	Off	Off	Off	On	On	Off	On	Off
27	Off	Off	Off	On	On	Off	On	On
28	Off	Off	Off	On	On	On	Off	Off
29	Off	Off	Off	On	On	On	Off	On
30	Off	Off	Off	On	On	On	On	Off
31	Off	Off	Off	On	On	On	On	On
32	Off	Off	On	Off	Off	Off	Off	Off
33	Off	Off	On	Off	Off	Off	Off	On
34	Off	Off	On	Off	Off	Off	On	Off
35	Off	Off	On	Off	Off	Off	On	On
36	Off	Off	On	Off	Off	On	Off	Off
37	Off	Off	On	Off	Off	On	Off	On
38	Off	Off	On	Off	Off	On	On	Off
39	Off	Off	On	Off	Off	On	On	On
40	Off	Off	On	Off	On	Off	Off	Off
41	Off	Off	On	Off	On	Off	Off	On
42	Off	Off	On	Off	On	Off	On	Off
43	Off	Off	On	Off	On	Off	On	On
44	Off	Off	On	Off	On	On	Off	Off

Node No.	8	7	6	5	4	3	2	1
45	Off	Off	On	Off	On	On	Off	On
46	Off	Off	On	Off	On	On	On	Off
47	Off	Off	On	Off	On	On	On	On
48	Off	Off	On	On	Off	Off	Off	Off
49	Off	Off	On	On	Off	Off	Off	On
50	Off	Off	On	On	Off	Off	On	Off
51	Off	Off	On	On	Off	Off	On	On
52	Off	Off	On	On	Off	On	Off	Off
53	Off	Off	On	On	Off	On	Off	On
54	Off	Off	On	On	Off	On	On	Off
55	Off	Off	On	On	Off	On	On	On
56	Off	Off	On	On	On	Off	Off	Off
57	Off	Off	On	On	On	Off	Off	On
58	Off	Off	On	On	On	Off	On	Off
59	Off	Off	On	On	On	Off	On	On
60	Off	Off	On	On	On	On	Off	Off
61	Off	Off	On	On	On	On	Off	On
62	Off	Off	On	On	On	On	On	Off
63	Off	Off	On	On	On	On	On	On
64	Off	On	Off	Off	Off	Off	Off	Off
65	Off	On	Off	Off	Off	Off	Off	On
66	Off	On	Off	Off	Off	Off	On	Off
67	Off	On	Off	Off	Off	Off	On	On
68	Off	On	Off	Off	Off	On	Off	Off
69	Off	On	Off	Off	Off	On	Off	On
70	Off	On	Off	Off	Off	On	On	Off
71	Off	On	Off	Off	Off	On	On	On
72	Off	On	Off	Off	On	Off	Off	Off
73	Off	On	Off	Off	On	Off	Off	On
74	Off	On	Off	Off	On	Off	On	Off
75	Off	On	Off	Off	On	Off	On	On
76	Off	On	Off	Off	On	On	Off	Off
77	Off	On	Off	Off	On	On	Off	On
78	Off	On	Off	Off	On	On	On	Off
79	Off	On	Off	Off	On	On	On	On
80	Off	On	Off	On	Off	Off	Off	Off
81	Off	On	Off	On	Off	Off	Off	On
82	Off	On	Off	On	Off	Off	On	Off
83	Off	On	Off	On	Off	Off	On	On
84	Off	On	Off	On	Off	On	Off	Off
85	Off	On	Off	On	Off	On	Off	On
86	Off	On	Off	On	Off	On	On	Off
87	Off	On	Off	On	Off	On	On	On
88	Off	On	Off	On	On	Off	Off	Off
89	Off	On	Off	On	On	Off	Off	On
90	Off	On	Off	On	On	Off	On	Off
91	Off	On	Off	On	On	Off	On	On

Node No.	8	7	6	5	4	3	2	1
92	Off	On	Off	On	On	On	Off	Off
93	Off	On	Off	On	On	On	Off	On
94	Off	On	Off	On	On	On	On	Off
95	Off	On	Off	On	On	On	On	On
96	Off	On	On	Off	Off	Off	Off	Off
97	Off	On	On	Off	Off	Off	Off	On
98	Off	On	On	Off	Off	Off	On	Off
99	Off	On	On	Off	Off	Off	On	On
100	Off	On	On	Off	Off	On	Off	Off
101	Off	On	On	Off	Off	On	Off	On
102	Off	On	On	Off	Off	On	On	Off
103	Off	On	On	Off	Off	On	On	On
104	Off	On	On	Off	On	Off	Off	Off
105	Off	On	On	Off	On	Off	Off	On
106	Off	On	On	Off	On	Off	On	Off
107	Off	On	On	Off	On	Off	On	On
108	Off	On	On	Off	On	On	Off	Off
109	Off	On	On	Off	On	On	Off	On
110	Off	On	On	Off	On	On	On	Off
111	Off	On	On	Off	On	On	On	On
112	Off	On	On	On	Off	Off	Off	Off
113	Off	On	On	On	Off	Off	Off	On
114	Off	On	On	On	Off	Off	On	Off
115	Off	On	On	On	Off	Off	On	On
116	Off	On	On	On	Off	On	Off	Off
117	Off	On	On	On	Off	On	Off	On
118	Off	On	On	On	Off	On	On	Off
119	Off	On	On	On	Off	On	On	On
120	Off	On	On	On	On	Off	Off	Off
121	Off	On	On	On	On	Off	Off	On
122	Off	On	On	On	On	Off	On	Off
123	Off	On	On	On	On	Off	On	On
124	Off	On	On	On	On	On	Off	Off
125	Off	On	On	On	On	On	Off	On
126	Off	On	On	On	On	On	On	Off
127	Off	On	On	On	On	On	On	On
128	On	Off	Off	Off	Off	Off	Off	Off
129	On	Off	Off	Off	Off	Off	Off	On
130	On	Off	Off	Off	Off	Off	On	Off
131	On	Off	Off	Off	Off	Off	On	On
132	On	Off	Off	Off	Off	On	Off	Off
133	On	Off	Off	Off	Off	On	Off	On
134	On	Off	Off	Off	Off	On	On	Off
135	On	Off	Off	Off	Off	On	On	On
136	On	Off	Off	Off	On	Off	Off	Off
137	On	Off	Off	Off	On	Off	Off	On
138	On	Off	Off	Off	On	Off	On	Off

Node No.	8	7	6	5	4	3	2	1
139	On	Off	Off	Off	On	Off	On	On
140	On	Off	Off	Off	On	On	Off	Off
141	On	Off	Off	Off	On	On	Off	On
142	On	Off	Off	Off	On	On	On	Off
143	On	Off	Off	Off	On	On	On	On
144	On	Off	Off	On	Off	Off	Off	Off
145	On	Off	Off	On	Off	Off	Off	On
146	On	Off	Off	On	Off	Off	On	Off
147	On	Off	Off	On	Off	Off	On	On
148	On	Off	Off	On	Off	On	Off	Off
149	On	Off	Off	On	Off	On	Off	On
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151	On	Off	Off	On	Off	On	On	On
152	On	Off	Off	On	On	Off	Off	Off
153	On	Off	Off	On	On	Off	Off	On
154	On	Off	Off	On	On	Off	On	Off
155	On	Off	Off	On	On	Off	On	On
156	On	Off	Off	On	On	On	Off	Off
157	On	Off	Off	On	On	On	Off	On
158	On	Off	Off	On	On	On	On	Off
159	On	Off	Off	On	On	On	On	On
160	On	Off	On	Off	Off	Off	Off	Off
161	On	Off	On	Off	Off	Off	Off	On
162	On	Off	On	Off	Off	Off	On	Off
163	On	Off	On	Off	Off	Off	On	On
164	On	Off	On	Off	Off	On	Off	Off
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167	On	Off	On	Off	Off	On	On	On
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169	On	Off	On	Off	On	Off	Off	On
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181	On	Off	On	On	Off	On	Off	On
182	On	Off	On	On	Off	On	On	Off
183	On	Off	On	On	Off	On	On	On
184	On	Off	On	On	On	Off	Off	Off
185	On	Off	On	On	On	Off	Off	On

Node No.	8	7	6	5	4	3	2	1
186	On	Off	On	On	On	Off	On	Off
187	On	Off	On	On	On	Off	On	On
188	On	Off	On	On	On	On	Off	Off
189	On	Off	On	On	On	On	Off	On
190	On	Off	On	On	On	On	On	Off
191	On	Off	On	On	On	On	On	On
192	On	On	Off	Off	Off	Off	Off	Off
193	On	On	Off	Off	Off	Off	Off	On
194	On	On	Off	Off	Off	Off	On	Off
195	On	On	Off	Off	Off	Off	On	On
196	On	On	Off	Off	Off	On	Off	Off
197	On	On	Off	Off	Off	On	Off	On
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199	On	On	Off	Off	Off	On	On	On
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203	On	On	Off	Off	On	Off	On	On
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206	On	On	Off	Off	On	On	On	Off
207	On	On	Off	Off	On	On	On	On
208	On	On	Off	On	Off	Off	Off	Off
209	On	On	Off	On	Off	Off	Off	On
210	On	On	Off	On	Off	Off	On	Off
211	On	On	Off	On	Off	Off	On	On
212	On	On	Off	On	Off	On	Off	Off
213	On	On	Off	On	Off	On	Off	On
214	On	On	Off	On	Off	On	On	Off
215	On	On	Off	On	Off	On	On	On
216	On	On	Off	On	On	Off	Off	Off
217	On	On	Off	On	On	Off	Off	On
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228	On	On	On	Off	Off	On	Off	Off
229	On	On	On	Off	Off	On	Off	On
230	On	On	On	Off	Off	On	On	Off
231	On	On	On	Off	Off	On	On	On
232	On	On	On	Off	On	Off	Off	Off

Node No.	8	7	6	5	4	3	2	1
233	On	On	On	Off	On	Off	Off	On
234	On	On	On	Off	On	Off	On	Off
235	On	On	On	Off	On	Off	On	On
236	On	On	On	Off	On	On	Off	Off
237	On	On	On	Off	On	On	Off	On
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239	On	On	On	Off	On	On	On	On
240	On	On	On	On	Off	Off	Off	Off
241	On	On	On	On	Off	Off	Off	On
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243	On	On	On	On	Off	Off	On	On
244	On	On	On	On	Off	On	Off	Off
245	On	On	On	On	Off	On	Off	On
246	On	On	On	On	Off	On	On	Off
247	On	On	On	On	Off	On	On	On
248	On	On	On	On	On	Off	Off	Off
249	On	On	On	On	On	Off	Off	On
250	On	On	On	On	On	Off	On	Off
251	On	On	On	On	On	Off	On	On
252	On	On	On	On	On	On	Off	Off
253	On	On	On	On	On	On	Off	On
254	On	On	On	On	On	On	On	Off

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